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Distribution of wheat disease black point (Kernel Smudge) in India

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Abstract

Black Point (BP) or Kernel Smudge is major limiting factor for milling and baking property of chapatti and bread respectively in terms of wheat quality deterioration in India. Grain characters related to its size and shape influence the milling yield and harvests with bold grains ensure better returns for the farmer. Extensive field surveys were done in different states of India from 2012 to 2015 to monitor wheat grain samples for Black Point (BP) incidence and severity. During 2012-13 to 2014-15, 19406 grain samples were analyzed at Plant Pathology lab under Crop Protection division of ICAR-Indian Institute of Wheat and Barley Research, Karnal, India for knowing the Black Point incidence and range of infection in different samples of wheat received from different states of India. The study indicates that Black Point was prevalent during 2012-13 to 2014-15 in states of North Western Plain Zone (NWPZ) from where samples were analyzed but there was difference in the disease incidence in different states. Wide variation in the range of infection existed in different states of India wherein indicates the role of weather factors prevailing in different states at vulnerable stage of the crop in disease outbreak.

Keywords: Wheat, Black Point, *Bipolaris sorokiniana*, Percent Infection, Grain Markets

Introduction

Agriculture plays a vital role in the economy and stability of India. India's agriculture is composed of many crops, with the foremost food staples being rice and wheat. Wheat (*Triticum aestivum* L.) is one of the most important food crops of the world. Wheat is primarily a rabi (winter) crop, and production is highly concentrated in the northern belt of Uttar Pradesh, Punjab, and Haryana, which together contribute 67% of total production and 55% of area (Joshi *et al.* 2007, Singh & Gogoi 2011) [1]. Wheat is grown over around 29.9 million hectare area in India with total production of 96.64 million tons in harvest season, 2016-17 and an average productivity of 3.6 t/ha. Furthermore, the expected demand of 100 million tons of wheat by 2030. Wheat is attacked by about 20 different diseases at various stages of its growth in Bangladesh (Ahmed, 1994). Among them, five are considered to be economically important because of their damaging nature and wide occurrence throughout the wheat growing areas of the country. Black point caused mainly by *Bipolaris sorokiniana*, *Alternaria alternata*, *Cladosporium cladosporioides*, *Curvularia lunata* and *Fusarium* spp. is one of them (Fakir, 1998) [2]. The most commonly isolated fungus from discolored kernels is *A. alternata*, followed by *C. sativus* 10 (Fernandez *et al.*, 1994b) [3]. The disease is characterized by brown to black discoloration usually restricted to the embryonic end of the grain, but in case of severe infection, the whole grain may be discoloured and shrivelled (Hanson and Christensen, 1953; Adlakha and Joshi, 1974) [4]. The disease occurs almost all over the world wherever wheat is grown (Mathur and Cunfer, 1993). Black point infection becomes severe when prolonged wet weather prevails during grain filling period of the crop. Black point has an adverse effect on seed weight, germination, and seedling emergence (Khanum *et al.*, 1987; Rahman and Islam, 1998) [6, 8]. The symptoms of Black Point the embryo tip shows a black to brown discoloration that may extend into the crease of the kernel.

Material and Methods

During 2012-13 to 2014-15, 19406 grain samples were analyzed at Plant Pathology lab under Crop Protection division of ICAR-Indian Institute of Wheat and Barley Research, Karnal, India for knowing the Black Point incidence and range of infection in different samples of wheat received from different states of India. Extensive post-harvest surveys were conducted across the state during April-May 2012 to 2015 and samples of wheat kernels were collected from various grain markets representing farmers 'produce. Five primary samples of approximately 200g each were drawn at random from each lot.

The samples thus collected were thoroughly mixed to form composite sample in Boerner type divider, to ensure homogeneity. Thereafter, a working sample of 250 g was drawn from each sample for conducting studies. Out of the working sample, 2000 seeds were drawn randomly and spread on purity board for the analysis of black point incidence. Percent infected samples as well as percent infection was calculated as follows: The percent disease incidence was calculated by using the formulae: $(\text{Number of samples having black point grains} / \text{Total No. of samples}) \times 100$. The level of disease severity in each of the samples was calculated by the formulae: $\text{Severity} = (\text{Number of black point grains in a sample} / 2000) \times 100$.

Results and Discussion

Infection pattern of black point and Percentage of infection under different states of India during 2012-13, 2013-14 and 2014-15 harvest seasons is presented in Fig. 1-2. During the Year 2012-2013, 2013-14 and 2014-15 harvest season out of total 5194, 5703 and 8509 wheat samples respectively analyzed, 78.85 %, 78.94 and 73.25 samples were infected with BP respectively with infection range of 0 to 9.50 (Table. 1). During 2012-13, out of 1601 samples were collected by Ludhiana centre from different grain markets of Punjab (Table.1). Highest BP infected samples were from Punjab followed by Uttarakhand, Rajasthan and Haryana. The Highest incidence (98%) was recorded from Punjab. In Haryana, out of 1900 samples analyzed 69 percent were found infected with BP. From Rajasthan out of 589 samples analyzed in which 85.9 percent found infected. From M.P., out of 224 samples analyzed 52.67 percent were found infected with BP with infection range up to 0-0.260 percent. In Uttarakhand, Uttar Pradesh out of 79 samples, and 288 samples collected for analyzed, 89.87 % and 30.9 % respectively were found infected with BP. Samples from Gujarat (Vijapur), Maharashtra (Pune), and Karnataka (Dharwad) out of 380 samples, 50 samples and 83 samples received for analyzed 50.26 percent, 88 percent, 49.39 percent respectively were found infected with Black point with infection range 0-8.50 0-1.90 and 0-0.35.

During 2013-14, in the State of Punjab; harvest Season 2014, the highest incidence (100 %) was recorded with infection range of 0.63-1.025. In Haryana, Total 1769 samples analyzed in which 70.15 percent were found infected with Black Point. A Total 720 samples were received by Rajasthan state from different grain market (Mandies). The disease prevalence was lower during the current year and 80.41 percent samples were found infected with Black Point with infection range 0.0-1.05

percent. The State Uttarakhand, Total 82 grains samples analyzed 54.87 percent were found infected with Black point with infection range up to 0-1.1 percent. Out of 256 samples analyzed, 71.48 percent were infected with Black Point from the State of Eastern Uttar Pradesh. In Madhya Pradesh out of 294 wheat samples analyzed then 75.84 percent samples were Black Point Infected. Based on the overall Black Point occurrence, it emerged that the BP incidence this year was more than the previous year (2012-13). After analysis at IIWBR, Karnal Laboratory Total 490 sample, 112 samples, and 102 samples from Gujarat (Vijapur), Maharashtra (Pune) and Karnataka (Dharwad) were received for analysis of Black Point disease in which 47.75 percent 84.82 percent and 23.52 percent respectively infected with BP. The Black Point (BP) incidence during Crop Season 2014-15 year was lowest as compared to the earlier years (2013 and 2014 Crop Season). In all, 8509 Total grain samples collected from various grain markets in different Wheat growing zones were analyzed. In North Western Peninsular Zone, the highest incidence was recorded from samples of Punjab, (99.86 %), followed by Eastern Uttar Pradesh where 90.05 percent samples had shown the infection During the Crop season 2014-15. In Haryana, 64.23 percent samples were found infected. In Rajasthan Black Point incidence was higher this year (2015) than the previous Crop year (2013- 2014). In Uttarakhand out of 82 samples analyzed 34.14 percent were infected. In M.P. out of 761 samples, 51.11 percent samples were BP infected. Total 536 sample, 519 samples, and 178 samples from Gujarat (Vijapur), Maharashtra (Pune) and Karnataka (Dharwad) were received for analysis of Black Point disease in which 21.8 percent 64.16 percent and 58.98 percent respectively infected with BP. Based on the overall Black Point occurrence, it emerged that the BP incidence this year was less than last two year. Severity & prevalence of disease varies between years and is dependent on weather conditions and susceptible varieties grown. Three years harvest season data indicated that black point was more aggressive in states falling in category of north-western plain zones (NWPZ). In north-eastern plain zones (NEPZ), Central zone (CZ) and Peninsular zone (PZ) the disease prevalence was less. The temperature and relative humidity during harvest season affected the disease pattern and their distribution in six agro-climatic zones of India. During harvest season generally the temperature was high in CZ and PZ compare to NEPZ and NWPZ. Between NEPZ and NWPZ, the temperature was high in NEPZ. So, climatic condition adversely affected the quality of seeds in terms of black point incidence.

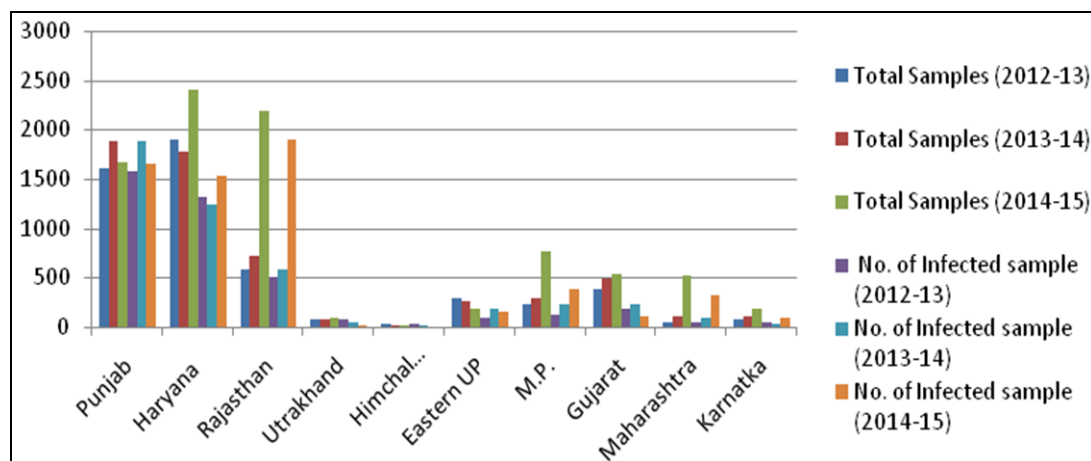


Fig1: Infection pattern of black point in Indian states

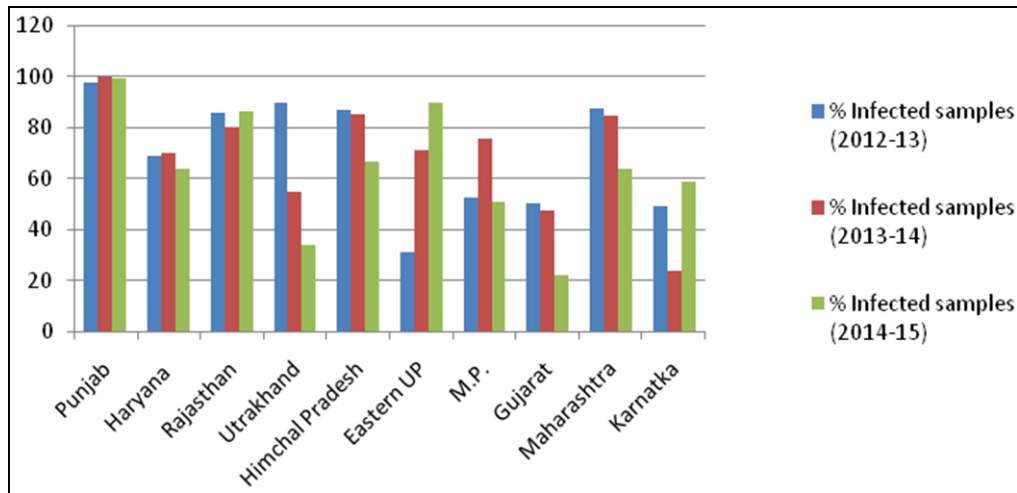


Fig 2: Percentage of infection under different states of India

Table 1: Range of infection under harvest season, 2012-13, 2013-14 & 2014-15

Indian states	Range of Infection (2012-13)	Range of Infection (2013-14)	Range of Infection (2014-15)
Punjab	0-1.01	0.63-1.025	-
Haryana	0-3.05	0-5.00	0-2.75
Rajasthan	0-7.50	0-1.05	0-0.25
Utrakhand	0-1.0	0-1.1	0-0.2
Himchal Pradesh	0-0.65	0-1.8	0-0.35
Eastern UP	-	0-1.1	0-1.25
M.P.	0-0.260	0-2.0	0-1.15
Gujarat	0-8.50	0-9.5	0-5.6
Maharashtra	0-1.90	0-4.2	0-0.60
Karnatka	0-0.35	0-0.5	0-0.45



Fig 3: Black discoloration of the embryo end of infected kernels.



Fig 4: Wheat seed lot with black pointed kernels

4. Conclusions

Black Point or Kernel Smudge of wheat caused by *Bipolaris sorokiniana* is becoming an alarming situation in Wheat growing area. The study indicates that Black Point was prevalent during 2012-15 in states of NWPZ from where samples were analyzed but there was difference in the disease incidence in different states. Weather conditions and other environmental factors helped the pathogen to cause the disease in wheat varieties. As the pathogen is seed borne, it can penetrate locally into host plant. Based on the overall BP occurrence, it emerged that the BP incidence this year (2013-14) was higher and more prevalent than other two crop year. Pathogenicity of these fungi in causing black point was confirmed experimentally the following year.

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